Fire and Rescue Departments of Northern Virginia

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The following committee members assisted in the development of the first edition of the manual (released in [DATE]):
City of Alexandria: Mark W. Dalton
Arlington County: Jeffrey M. Liebold
City of Fairfax: Joel A. Hendelman
Fairfax County: Jeffrey B. Coffman, John J. Caussin, Michael A. Deli, Floyd L. Ellmore, John M. Gleske, Larry E. Jenkins, David G. Lange, Thomas J. Wealand
Metropolitan Washington Airports Authority: Chris Larson

The following Writing Group members managed the revisions creating the second edition of the manual:
Dan Shaw, Fairfax County Fire and Rescue Department (lead)
Scott Kraut, Fairfax County Fire and Rescue Department

The following Fire Operations Board members assisted in the revision creating the second edition of the manual:
City of Alexandria: Dwayne Bonnette
Arlington County: Dale Smith, Donald Brown
City of Fairfax: Andy Vita, Mark Ciarrocca
Fairfax County: J.J. Walsh, Keith Johnson
Fort Belvior: Richard Monroe
Fort Myer: John Pine, Roger Rearden
Loudoun County: Mike Nally, Scott Lantz
Metropolitan Washington Airports Authority: Scott Chamberlin, Dominic Depaolis
Prince William County: John Shifflett, Kevin Artone

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PREFACE

A fire in a strip shopping center in Northern Virginia can occur in buildings of various dimensions and construction features. The strip shopping center dates from post-World War II to the present; during this span, construction type has ranged from ordinary construction to lightweight. The majority of these structures are non-combustible.

Firefighters must realize these structures may not have fire protection systems in place, and construction features may contribute to the rapid horizontal spread of fire.

The life hazard to the firefighter in these occupancies is high. Potential hazards include:

- Collapsing roofs, floors, and walls
- Heavy fire loading
- Maze-like conditions
- Limited access and egress
- Complicated security measures
- Potential for undetected fires in the plenum space
- Hazardous materials
- Difficult roof top ventilation
- Falling facades
- High entanglement potential

The key changes in the Second Edition of *Fires in Strip Shopping Centers* are as follows:

- Reformatting of manual layout and updated graphics.

OVERVIEW

The purpose of this manual is to describe the type of buildings that make up shopping centers. These structures make up a large portion of the commercial occupancies in Northern Virginia. This manual will identify construction features, inherent firefighting problems, operational priorities, known risks or hazards, and establish a standard method of operation for fighting fires in these types of structures.

DESCRIPTION

The term "strip shopping center" refers to commercial occupancies that are:

- joined by party walls or fire walls;
- covered by a common roof;
- occupied by a variety of businesses; and
- accessed by an individual exterior entrance on the first floor.

Characteristics

Strip shopping centers refer to long commercial structures, housing a variety of occupancies under one roof. They are normally constructed on large open lots. These lots consist of parking to the front and either side of the center with rear access for delivery. While there are small centers containing only specialty shops, the typical center has, as its core, a large anchor store (such as a supermarket, department store, or appliance store).

In more congested city settings, strip shopping centers may be found along entire city blocks with limited parking along the roadway. Delivery vehicles may have narrow rear alley access or may only have access through the front entrance.

Strip shopping centers in Northern Virginia are typically one-story lightweight and noncombustible construction; occasionally, two-story structures may be encountered. The walls are masonry or tilt-up concrete with steel bar joists supporting a metal deck roof. In older sections of Northern Virginia, ordinary construction may be found. The presence of basements is more likely in these older strip shopping centers.

Residential apartments or office space may be encountered above some strip shopping centers. The apartments are often referred to as “taxpayers”. Most taxpayers usually have a separate entrance not connecting to the store below. They are found in older structures, but can also be found in the newer, “town center complex” centers.

The dimensions of the stores in a strip shopping center are typically narrow and deep. The dimensions can vary greatly, but smaller stores may have dimensions on the order of 30' x 75'. The anchor stores, such as a supermarket, will be much wider than and at least as deep as the smaller occupancies. The width of these large stores can easily exceed 150 feet.

Adjacent occupancies may have a common cockloft. Old anchor stores may have been subdivided into several smaller businesses which share a common cockloft.

Storefronts have large plate glass or tempered glass windows and tempered glass doors in a metal frame.

Rear entry doors are typically metal and heavily secured with drop bars and additional locks. Rear windows usually are secured with metal bars or heavy mesh, Figure 1.

Figure 1 - Rear windows secured with metal bars.

Basements are usually accessed from the rear via an interior or exterior stair. Basements can extend beyond the occupancy from which they are accessed, Figure 2.

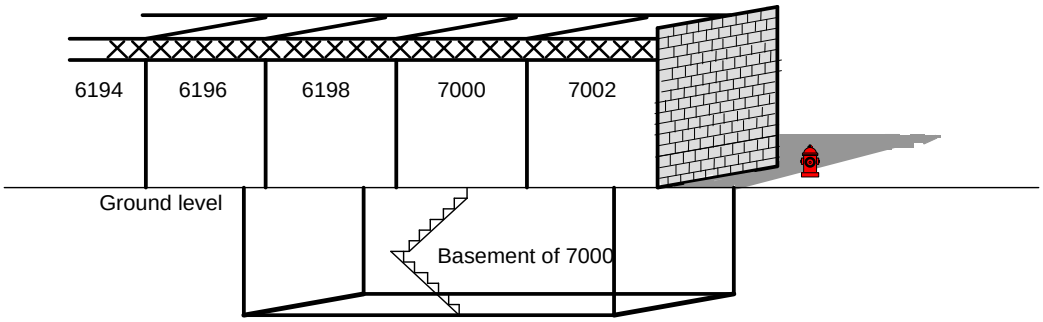

Figure 2 - Strip shopping basement example.

Firewalls may not be present between occupancies. The fire shown in Figure 3 entered the area above the ceiling and quickly traveled horizontally until brought under control using master streams.

Figure 3 - Firewalls may not be present between occupancies.

Fire loading in the strip shopping center may be moderate to heavy. Initial fire flow estimates should be based upon 20 GPM per 100 square feet of involved area. Engine companies should be prepared to use multiple 1 ¾-inch lines or a 2½-inch hose line.

Addresses may only be required on the front of each store. Identifying the individual occupancies in the rear may be difficult where numbers are not required, Figure 4.

Figure 4 – Identifying the individual occupancies in the rear may be difficult.

Some shopping centers have back-to-back stores with addresses on both sides and no rear access, Figure 5. Most often, there is a large parking lot out front and along the ends. The rear is normally accessed by a narrow driveway used for deliveries. This allows access to

four sides and staging of incoming apparatus, in most cases unless the rear is congested with other vehicles or obstacles.

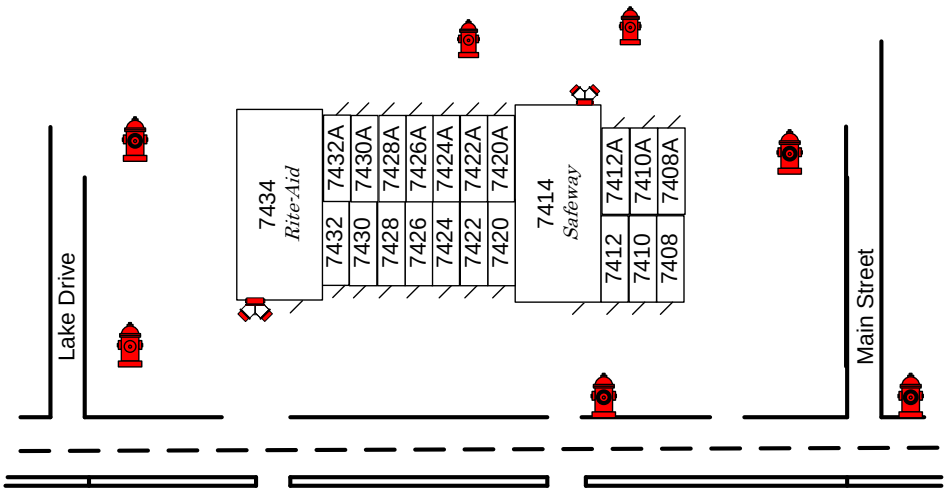

Figure 5 – Back-to-back stores with addresses on both sides and no rear access.

Rear Delivery Areas

The rears of the buildings are sometimes difficult to access, Figure 6. They may be blocked by dumpsters, compactors, delivery trucks, trailers, pallets, and cardboard storage. You may also find hazards such as low overhanging electric wires, gas meters, fuel oil tanks, LPG tanks, large potholes, and these areas are poorly lit at night.

Figure 6 – The rear of the buildings can be difficult to access.

Auxiliary Fire Protection Systems

Protection systems are inconsistent. Some centers have full or partial automatic sprinkler systems that may be wet or dry, while others have no sprinkler protection at all. Automatic sprinkler protection may be fed by the same main serving the hydrants in the parking lot. A bank of fire department connections may be encountered feeding various sections of the building. These connections, many times, are not clearly marked as to which section of the building they serve, and only pre-planning these structures helps firefighters identify methods for the proper charging of the system.

CONSTRUCTION

Type

Most strip shopping centers in Northern Virginia were built during the last 30 to 40 years and are of noncombustible construction. Those built prior to this time are typically ordinary construction. Some recent structures are being built using lightweight construction methods.

Cocklofts

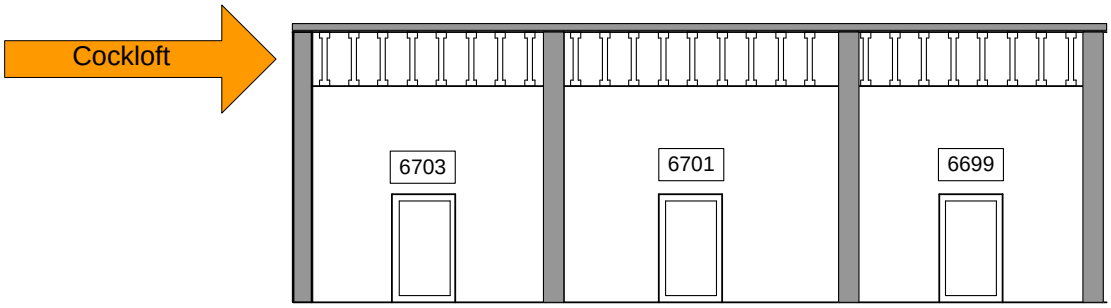

Figure 7 – The cockloft in a strip shopping center.

The cockloft is the area located above the ceiling and below the roof deck, Figure 7. It is not unusual to find the cockloft exposed in the rear storage area.

Modern codes require fire walls or party walls between occupancies. Older structures may not have any fire stopping between occupancies. In Figure 8, notice the lack of fire stopping between several occupancies and the lightweight steel bar joists.

Figure 8 – Lack of fire stopping between occupancies.

Non-fire rated draft stops made of gypsum or plywood slow down the horizontal movement of fire. They may be found in large cockloft areas, Figure 9. In large cockloft and attic areas these draft stops usually have penetrations allowing for wiring, ductwork, pipes, and large access holes for maintenance personnel.

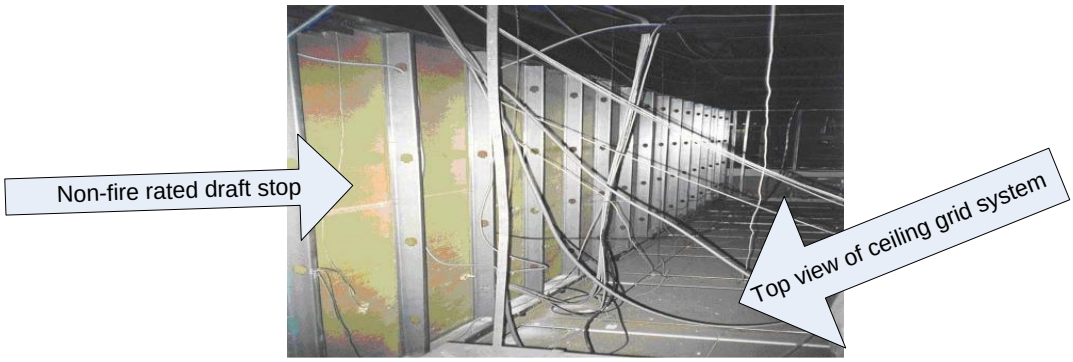

Figure 9 – Non-fire rated draft stops made of gypsum or plywood slow down the horizontal movement of fire.

Roofs

Strip shopping centers built of ordinary construction will have a wood roof assembly. The roof deck will be tongue and groove boards or plywood sheeting.

Laminated wooden arches that span a wide area and support the roof may be present. These were common in old Safeway stores. The roof covering is typically "built up" where a bituminous (asphalt-containing) material is laid directly over the wood and covered with roofing felt, then sealed with hot tar, and covered with gravel.

Strip shopping centers built of non-combustible construction will have roof assemblies supported by steel bar joists. The roof deck may be corrugated metal with a layer of insulation covered by tar paper and roofing tar or a rubber membrane, Figure 10. Below the bar joist in the retail area will be a fire-rated drop ceiling. The roof assembly in the storage area normally is not protected.

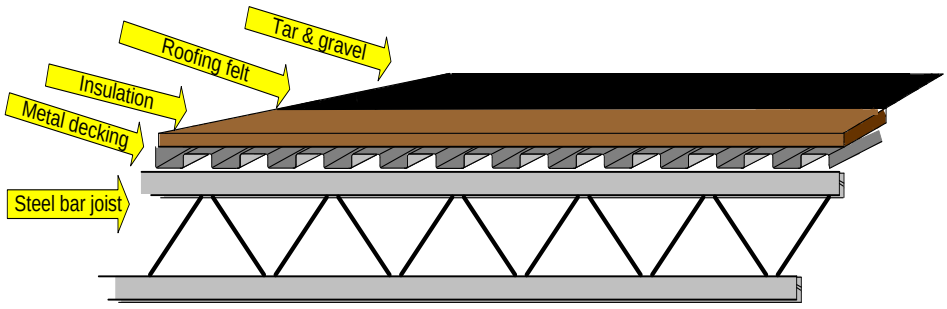

Figure 10 – Roof assembly supported by steel bar joists.

Lightweight concrete roofs are also common to these structures. The roof assembly consists of bar joist, metal decking, and concrete poured over the decking. Another type of concrete roof is the pre-cast “T” and double “T” panels found in tilt up construction, Figure 11.

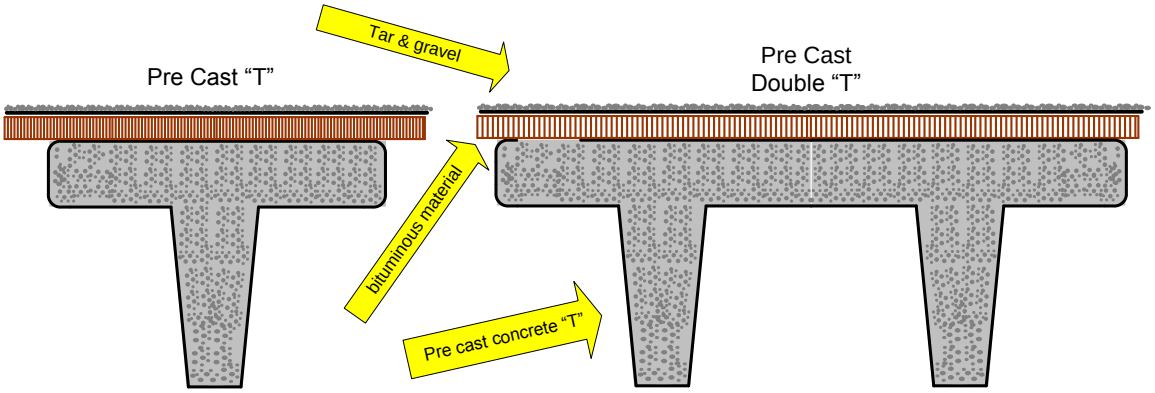

Figure 11 – Roof assembly with pre-case "T and double "T" panels.

Strip shopping centers that have been renovated will have a new roof assembly over the existing roof(s). This creates an additional undivided void space which is difficult to access, Figure 12. These roofs are also called rain roofs because they are built over existing roofs. The original roof was not designed to carry the extra weight of the new roof making it more vulnerable to early collapse.

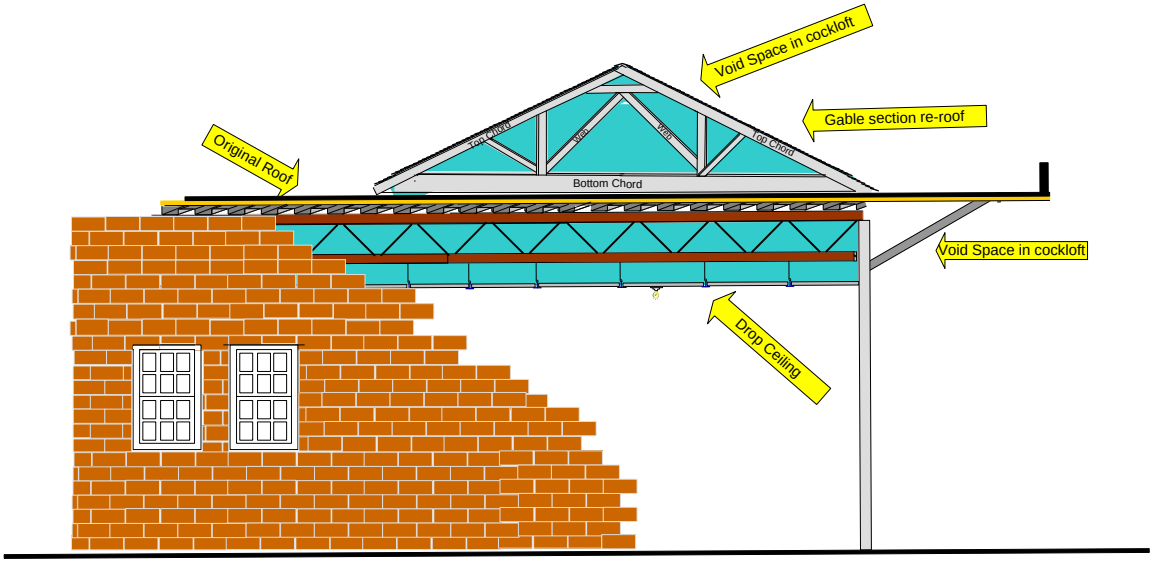

Figure 12 – New roof assembly over the existing roof.

Penetrations found in roofs may include skylights, scuttles, ventilators, and exhaust ducts.

Walls

The following types of walls are found in strip shopping centers:

- Load bearing – holds the weight of the structure and all forces applied.
- Non-load bearing – a wall bearing only its own weight (such as veneer, curtain, partition).
- Fire wall – designed to prevent or slow the horizontal progression of fire from occupancies built from the floor through the roof structure.
- Veneer – single thickness of a masonry material (ex: stone, brick, or block) added to the structure for aesthetic purposes.
- Party – load bearing wall separating occupancies not extending the roof line.
- Partition – divides an area within an occupancy not extending above the ceiling.

The method of wall construction can be pre-cast tilt-up, masonry, and wood/metal frame. Automatic sprinklers can reduce the required fire rating of the wall assembly. Often there will be no rated separation between groups of stores if all are the same occupancy type. The type of construction and occupancy dictates the need for a fire wall or fire separation.

The most effective firewalls run from the foundation through the roofline. They are usually masonry, and more substantial than occupancy fire separation walls. Some firewalls terminate below the roof line.

The stability of walls in tilt-up construction depends upon the roof assembly "tying" the building together. A typical tilt-up construction design is shown in Figure 13; should the roof assembly collapse down into the structure, the walls can be expected to fall outward.

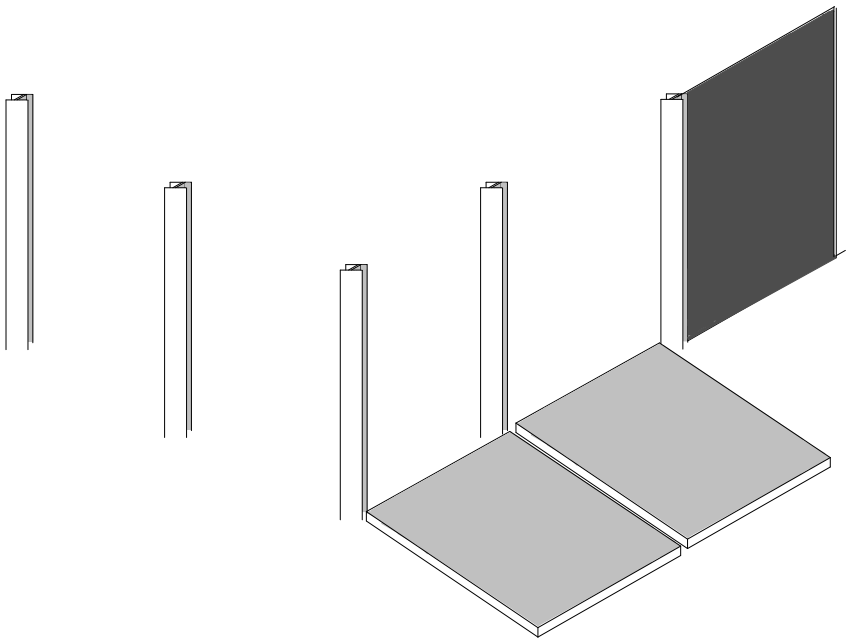

Figure 13 – Tilt-up construction design.

Normally the bearing walls of strip shopping centers run from front–to-back. The roof assembly, and occasionally the second floor, can expand and push out on the wall during fire situations.

Parapet walls extend upward above the edge of the roof, Figure 14. The parapet creates a drop that may require a ladder to descend down to the roof. Parapets are found in the front and sometimes sides; they are not typically found in the rear of the structure.

Figure 14 – Parapet walls on the edge of the roof.

Facades

A facade is an architectural projection that provides weather protection, occupancy identity, decoration, and is supported by the building to which it is attached. Draft stopping may be found at intervals in the concealed areas.

Floor Assemblies

The following types of floor assemblies are found in strip shopping centers:

- Reinforced concrete
- Dimensional lumber
- Lightweight wood
- Steel bar joist

In newer construction, fire separations should be expected between taxpayer residencies and commercial occupancies. In older construction, there may not be any type of fire separations between the commercial and residential units.

Basement Areas

The basement in strip shopping centers can be used for storage, offices, and/or other functions. A common basement may span under multiple addresses, Figure 15.

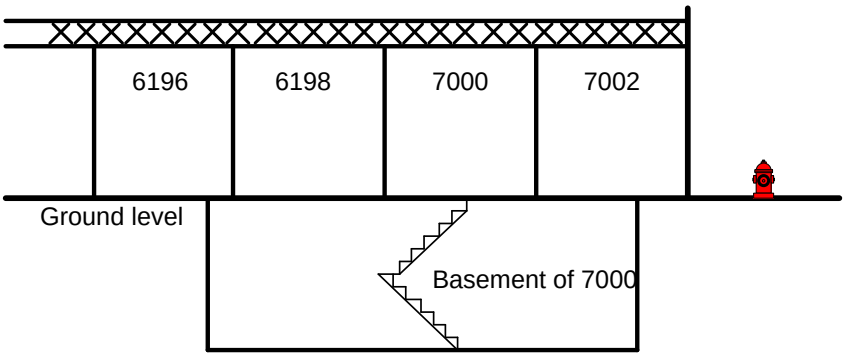

Figure 15 – A common basement may span under multiple addresses.

Access to basement areas will normally be from the interior. When an exterior entrance to the basement is present, it will normally be at the rear of the store, Figure 16.

Figure 16 – Basement access.

Exterior basement entrances may also be located in the sidewalk at the front or on one of the sides of the building, Figure 17. These entrances are usually under steel doors or grates. These entrances may simply be a set of steps, but can also contain conveyors, slides, or chutes for delivery of supplies into the basement. Conveyors, slides, or chutes are very good for ventilation, but should not be used for entering the basement.

Figure 17 – Basement entrance in the sidewalk.

The contents of strip shopping center basements will include many different materials. Firefighters should expect to find items not necessarily related to the business occupying the store above. Stock may be piled from floor-to-ceiling, making sprinkler systems less effective. Depending on the age of the structure, sprinklers may not be present.

Roll-Up Security Doors and Gates

To prevent crime after hours, store owners may use steel roll down security doors or gates, Figure 18. These roll down devices are found covering large glass openings on store fronts, and are secured and held in place by the guide rails that travel from the top of the door to the bottom on each side of the device. These doors can cover a single doorway or a complete store front. When the store front is completely covered, this may delay the discovery of the fire. Some of these doors will have a spring-loaded ratchet type of system to assist with opening and closing of the gate. The locking mechanism is usually a slide bolt with several locks.

Figure 18 - Roll down gates.

Entry and Exit Doors

Access and egress for the general public is found at store fronts, but, depending on the size and type of occupancy, there may be emergency exits in the rear. These areas can be obstructed by check-out counters, shopping carts, and merchandise displays; these obstructions are more prevalent during the major holiday seasons.

Not uncommon are two-story strip centers with separate occupancies on both levels. Access to the second story generally will be found at the ends or middle of the building from a common public area. Individual occupancies will lead off a common hallway. Large anchor stores may have a second mercantile floor occupying both levels where interior stairs, elevators, or escalators may be found.

The security device found at rear doors is normally the drop-in static bar, Figure 19. The brackets that hold the bars are attached to the door and frame by welding or bolting.

Figure 19 – Drop-in static bar, interior view (left) and exterior view (right).

A newer type of rear security, the "Maverick Bar"™, can be found in major electronic retailer stores and other retailers in high-crime areas, Figure 20. The bar attaches to the door frame and the door at four points in each corner. This device makes it more difficult to gain access from the exterior.

Figure 20 – Maverick bar. The photo on the far left shows the door without the bar in place. The middle photo shows one bar in place. The photo on the far right shows both bars in place.

HAZARDS

Life Hazards

The best way to determine a building hazard is by conducting a walk through during the construction phase. On the other hand, the best way to determine the content hazards is by conducting yearly post-construction walk throughs.

It is expected that occupants present during normal business hours will self-evacuate in an emergency. There still may be people inside after business hours. Cleaning crews will lock themselves inside occupancies for security. In family-owned businesses, sleeping areas have been observed.

Life hazards in two-story strip shopping centers can be more significant. Occupancies, such as apartments (taxpayer), offices, and social halls, may be found in areas above and below street level. Due to this feature, the life hazard is potentially high at all times of the day and night.

Firefighters on the roof should be cognizant of changes in the depth of the individual stores along the rear of the shopping center. For example, one store may be 90 feet front to back and the adjoining store only 75 feet front to back, Figure 21.

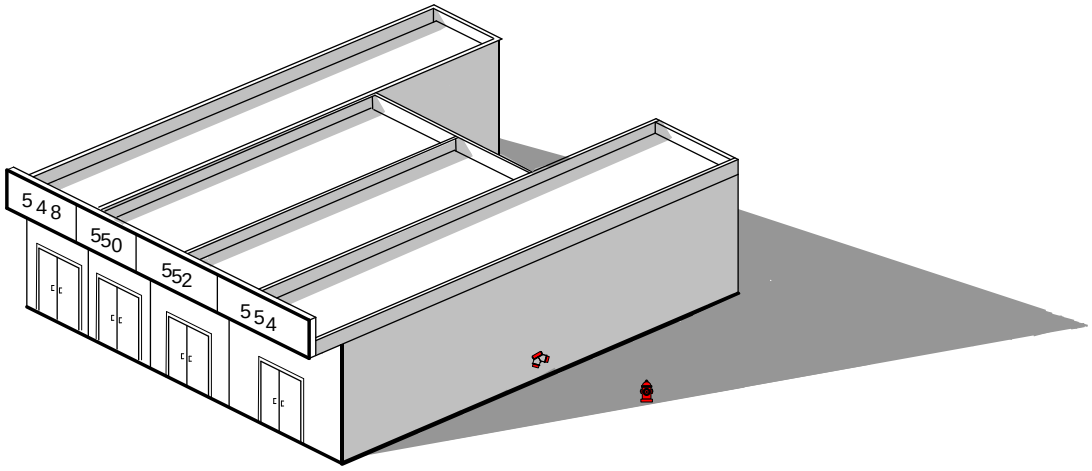

Figure 21 – Varying store depths.

Parapets running front to rear are often used to separate occupancies. Members must be aware that the roofline on either side of these parapets may not be at the same depth from front to rear.

Collapse

Bulges, cracks, and smoke seeping are all indicators of possible wall collapse. When observed, a collapse zone distance at least one and a half times the height of the wall must be maintained.

The potential for structural collapse at a strip shopping center is dependent upon several variables. The type of construction along with the size, intensity, and duration of a fire are all factors that can contribute to collapses. Collapses generally involve roof structures and the cantilever facades or marquees.

The front walls of most buildings are considered veneer with the facade connected. Facades are free-standing or supported, and can include a parapet, marquee, canopy, or a cornice. When steel trusses are heated and expand, they may push the facade causing a collapse.

Given the use of trusses in strip shopping center construction, partial collapse of the roof should be anticipated in situations of advanced fires. The roofs and floors may have metal or masonry systems including metal deck and steel bar joists. The walls may be constructed of metal or masonry. Large fires will compromise the roof structures and damage the unprotected steel, destroying the building's integrity. At 1000^0 F, steel will twist and expand, causing failure or pushing out exterior walls. Figure 21 shows bar joists beginning to fail and frozen in place once cooled. Heavy loading on roof systems can add a tremendous amount of weight adding to collapse potential.

Figure 22 – Steel bar joists beginning to fail in high temperatures (left) and frozen in place once cooled (right).

Fires in the plenum space above the suspended ceiling may burn undetected, weaken the roof supports, and collapse, trapping personnel below. Two firefighters in Chesapeake, Virginia, were killed when the roof trusses and ceiling collapsed. The cause of death was smoke inhalation and burns. They entered the store with no indications of fire above them. They responded for a report of an electric panel sparking. More information about this can be found at the NIOSH web site (http://www.cdc.gov/NIOSH/FIRE/).

This mass of grid members is practically impossible to escape once it falls over top of a person. Although illegal, merchants store combustibles above the drop ceiling. This adds weight to the ceiling system which may cause an early collapse under fire conditions.

Warning signs of imminent collapse:

- Fire burning for more the 20 minutes in ordinary construction or 10 minutes in lightweight truss construction.
- Smoke or water coming through mortar joints in walls.
- Walls that are sagging or bulging.
- New cracks showing in exterior walls.
- Heavy floor or roof loads under fire conditions.
- Spongy roof surface due to fire below.

When a building has been renovated, the potential for early collapse must be considered. When a second roof or rain roof is placed over an existing roof, there are numerous void spaces where fires can burn undetected for long periods of time and cause considerable damage before being discovered, Figure 23. The original roof was not designed to carry the extra weight of the new roof making it more vulnerable to early collapse.

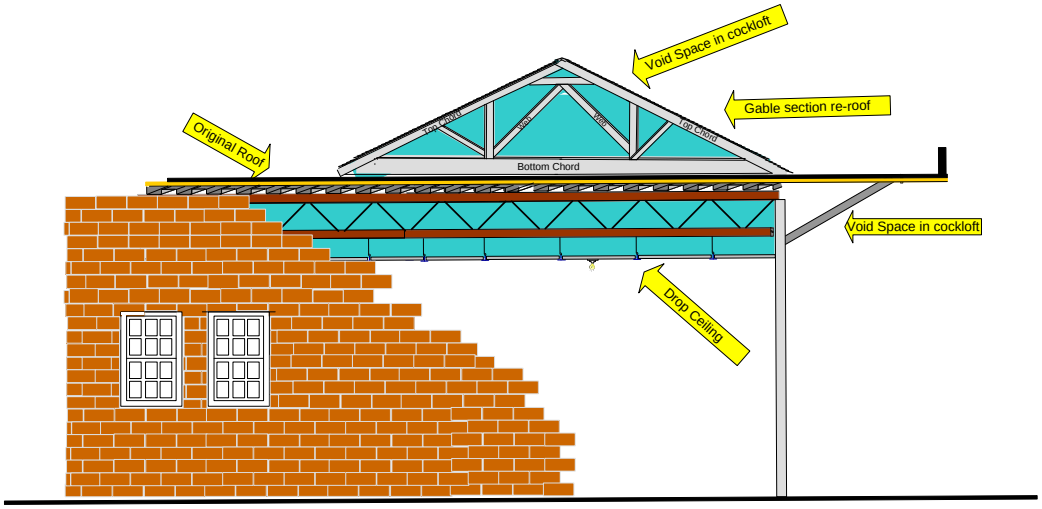

Figure 23 – When a second roof is placed over an existing roof, there are numerous void spaces where fires can burn undetected for long periods of time and cause considerable damage.

Hazardous Materials

Hazardous materials in quantities that do not require placards may be found in any type of occupancy from hardware stores to grocery stores.

Backdrafts and Flashover

Backdrafts can take place in any type of closed structure. Although, when they occur in strip shopping centers, they tend to be catastrophic. Built-up roofs are time-consuming and difficult to ventilate. The delay in ventilation, accompanied with large amounts of store front glass in well-advanced fires, make the potential for backdrafts more treacherous and difficult to alleviate. In well-advanced fires, prior to roof ventilation, advancing companies should remove the glass, delay entry, allow the fire to show itself,

and relieve some of the heat and smoke prior to making entry.

The potential for backdraft is also possible in the plenum spaces above the ceiling and in remodeled roofs where the new roof is built over an existing roof leaving dead areas. Flashover is another phenomenon that may be encountered in these types of structures and the tactics are discussed in the tactics section.

Fire Extension

In one-level structures, horizontal fire spread or extension is the most significant concern. Fire separations are not required between all occupancies. Fire may spread through unprotected areas such as ceiling spaces, facades, or breaches in walls.

Restaurant hood systems have several unique problems that need to be addressed. When the fire has entered the duct system, the following actions are necessary:

- Check for extension above the membrane drop ceiling as you walk to the grease duct area.
- Remove power from the grease pit.
- Activate the hood system dry chemical extinguisher.
- Roll grease pit away if applicable.
- Do not place hose stream into overhead duct with hot grease under the duct. Water running back down into the hot grease may create a violent steam boil over.
- The least damaging method of extinguishment is the application of multiple CO_2 extinguishers into the duct. Delay removing the roof-top ventilator until this extinguishment method has been completed.
- Another popular method is to discharge several ABC/dry chemical extinguishers up into the duct work.
- Removing the top ventilator cover reduces the horizontal fire spread.
- Make a thorough inspection for extension.
- Notify the health department.

In occupancies with restaurants, associated fans and ducts will be present. Shut down all cooking appliances and secure utilities. Control of these devices by shutting down the fans and check these areas by opening up ductwork. Be aware of hot grease and oil in the restaurant.

Fire may originate in the cockloft area due to defective electrical work or grease-laden ducts; anticipate significant horizontal extension when this occurs.

Hazards Associated with Hoseline Advancement

Advancing hoselines into strip shopping center occupancies can be difficult due to overcrowded aisles. Flashover and rollover across elevated ceilings may be a result of a well-advanced fire distant from the point of entry.

Hazards Associated with Basements

Operations in the basements of strip shopping center occupancies are especially hazardous due to the stock arrangement and stairwell location. Entry can be difficult due to the amount of potential combustibles and lack of ventilation access. The potential for falling stock to block hoseline advancement, or impede firefighters' means of egress must be considered

Units advancing into the structure must be cognizant of the stability of the floor as well as the roof or ceiling assembly above. A constant evaluation of these structural members, sometimes by another crew, is necessary to ensure a safe operation. This is of particular importance as crews advance deeper into the structure.

FIRE OPERATIONS

Strategic Factors

As with any type of structure, an on-going size up should include a risk/benefit analysis. This information should include structural stability, life hazards, and exposure protection.

If a taxpayer-type occupancy is involved in the fire scenario, the normal strip shopping center tactics need to be adjusted. Consideration for the life hazards from both the commercial and residential occupancies are the first priority.

First Alarm Resources

The minimum resources assigned to fires in strip shopping centers are:

- 4 engine companies
- 2 truck companies
- 1 rescue company
- 1 EMS unit
- 2 battalion chiefs
- 1 command aide (Arlington and Alexandria)
- 2 EMS supervisors (1 EMS supervisor Arlington and Alexandria)

Apparatus Positioning/Initial Assignments

The first engine should lay appropriate supply line(s) and take a position on the front of the building while leaving room for the aerial apparatus. The first engine shall give a preliminary lay out report, on- scene report, size-up report, and initially assign units to tactically mitigate the situation.

The second engine shall ensure that a water supply is established to the first engine and building fire protection systems. When multiple unmarked connections are present, ensure all connections are charged. This company is responsible for deploying the back-up line.

The third engine shall position in the rear when possible. The third engine is responsible for hoseline operation in the rear and support of the rescue and truck companies operating in this area. Hoselines advanced through rear entrances to the involved store or into exposures must be coordinated with engines operating through the front to avoid opposing hoselines. Advise the incident commander of the rear conditions and if a sprinkler connection is located in the rear of the building and charge it if required.

The fourth engine shall assume the duties of the R.I.T. and water supply to the third engine in rear if needed.

The first truck should take a position in front of the involved store(s). This will allow for the use of the aerial for roof access, ground ladder deployment, use of the master stream

(particularly if the unit is a tower ladder, Figure 24), and auxiliary equipment on the unit when needed.

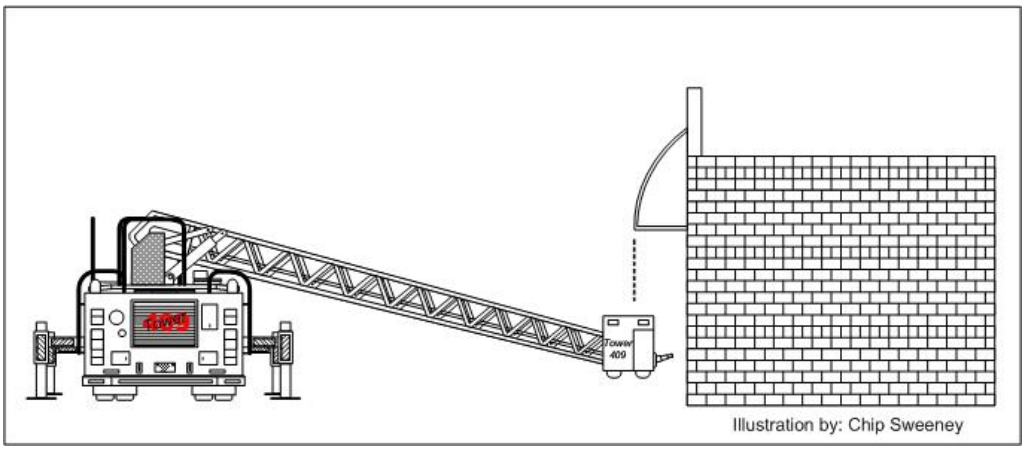

Figure 24 – Tower ladder master stream operation.

The second truck shall take a position in the rear with a primary assignment of gaining access to the roof. Use of the aerial is preferred but care must be given to overhead hazards. Lighting of the roof and the rear area should be addressed early. Give early situation report to command.

If heavy fire conditions are encountered requiring either an offensive exterior attack or defensive operations, the incident commander should use a tower ladder (or more than one if necessary) on side Alpha for mobile ground-level heavy caliber streams. Priority position in the front must be given to a tower ladder if one was on the original assignment or if one was ordered on a special call or greater alarm.

The rescue company should position in the rear. The rescue is primarily responsible for gaining access to the rear of the involved occupancy and the immediate exposures on both sides.

The EMS crew should be assigned to initial EMS duties with all needed equipment. The unit should position in an area that will not block fire apparatus and allow for unimpeded egress from the scene in the event of patient transport.

Units should avoid parking directly in front of the involved store to reduce exposure of personnel and apparatus in the event fire vents out the front show windows.

ENGINE COMPANY TACTICS

Water Supply

When dispatched for a fire in a strip shopping center, the first-arriving engine will lay supply line(s) to establish the water supply for fire attack. The location and method of the hose lay should be communicated to the second due engine company.

A forward (or straight) hose lay of a supply line(s) shall be used when possible. Modifications to this procedure may be made to ensure sufficient fire flow to extinguish the fire. Personnel should give consideration to laying dual lines because of the potential fire load in strip shopping centers.

In areas where hydrants are not readily available, the procedure for relay or shuttle operations will be followed.

On-Scene Report

The first arriving unit officer shall include the following information in the on-scene report:

- Water supply/layout location (if not previously reported)
- Corrected address, if different from dispatch
- Type of structure
- Incident conditions (e.g., fire showing from two windows on the first floor)

Size-Up and Situation Report

The first-arriving engine officer shall conduct a thorough "size-up." The "size-up" should note the location and extent of smoke and fire, rescues, access points, number of floors, utilities, and exposures. The information gathered from the size-up, as well as, the critical information relayed from units on Side "C" will dictate the mode of operation and tactics employed. Firefighting operations shall be coordinated with companies operating on Side "C" to ensure a fire attack is not made through both sides of the building at the same time. The size-up results are reported through the situation report, and shall include command statement (retain or transfer), initial assignments of on-scene companies, and requests for greater alarms, if needed.

Progress reports will follow, and should include the following: a thorough analysis of area of involvement, the potential life hazards, the need for additional resources, and how, if present, environmental factors, such as high winds, will impact the firefighting operation. Clear and concise communication of the operational mode, strategy, and tactics shall be communicated to all companies operating on the emergency incident.

Initial Line

Intensity, size, and location of the fire, along with available staffing, are the factors that determine what initial line must be deployed. A medium fire load requires 20 GPM per 100 square foot. A 25' X 50' foot store has 1250 square feet and would require 250 GPM. This GPM can be produced by one 2½-inch handline, or two 1¾-inch handlines with the 15/16-inch tips with a total flow of 370 GPM. A 2½-inch line requires two companies to maneuver inside a structure; two 1¾-inch lines require the same amount of staffing but result in an increase of 120 GPM.

The advancing hose crew must cool the ceiling as they move in to control the rapidly building fire along the ceiling. Ceiling tiles need to be removed to check the plenum space for advancing fire. This can be accomplished with long pike poles or hose streams. Additionally, a back-up line must be assigned to another crew to protect the rear of the advancing crew.

When fires have reached advanced stages and there is no life hazard, the use of master streams should strongly be considered.

Back-Up Line

The back-up line for most fires within these types of structures will need to be capable of delivering the same amount of water as the attack line or more.

The line should be of sufficient length to reach the location of the initial attack line or to be advanced to the area beyond the initial line, if required.

Exposure Protection

Horizontal fire spread or extension is the most significant concern in strip shopping centers. Fire separations are not required between each occupancy. Therefore, exposures to each side of the involved store must be examined early to check extension resulting from rapid mushrooming of heat and combustible gases under the roof.

Consider the time needed to gain access to the occupancies adjacent to the involved unit. Anticipate where the fire has traveled in the time since gaining access. Assurance must be made that the fire will be flanked or units will find themselves in a situation of trying to catch up to a rapidly extending fire.

Exposure designation starts with the number one and continues as shown in Figure 25. Normally, the exposures are easy to differentiate as shown below. Upon arrival, if you have more than one unit involved, Figure 26, the decision has to be made as to where the exposure identification starts. This needs to be communicated to all units working the incident. Once the incident commander makes the distinction of where the exposures starts the exposure numbering does not change even if the fire later extends to exposures. Figure 26 shows three units involved with fire and the exposure numbering starts at each flank.

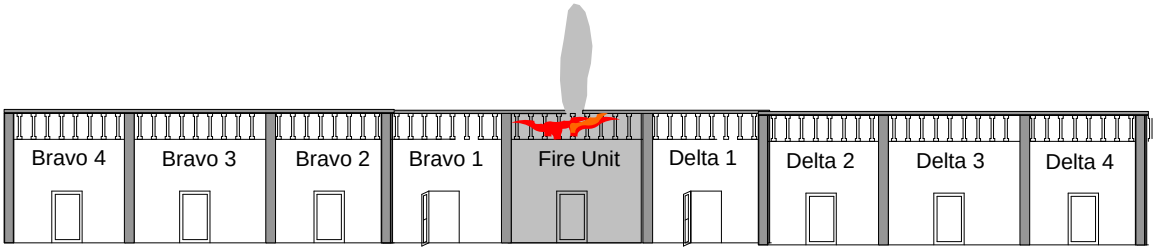

Figure 25 – Exposure numbering with one unit involved.

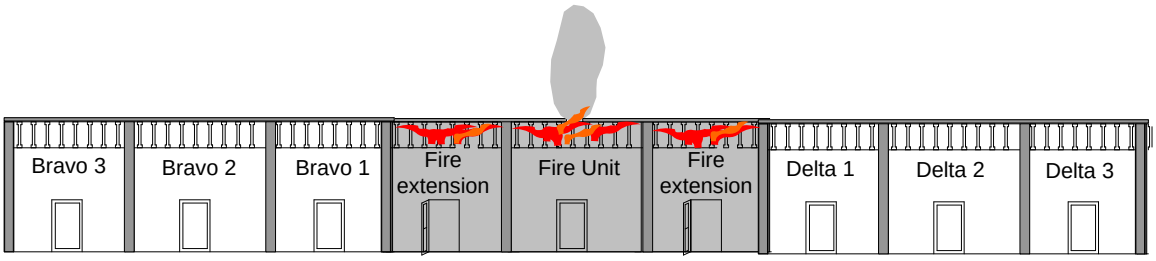

Figure 26 – Exposure numbering with three units involved.

Fire can rapidly spread horizontally, particularly in those buildings with little or no separations in the cockloft, Figure 27. Each exposure will be checked until no extension is found. This may require multiple companies to accomplish this task.

The use of positive pressure on each side of a fire will prevent smoke and fire from moving horizontally into the Bravo and Delta exposures. This procedure can be accomplished with the units checking for extension in these exposures. The company will enter the exposure by the front or rear door, check for extension, and remove several ceiling tiles. Once it has been determined that the fire hasn't extended, set up a fan blowing inward at the entrance door. If the fire has extended into the exposure, move down to the next. This will pressurize the exposure and prevent the smoke and fire from entering the exposure. While this operation is used, it is important to control the exposure opening size. Do not remove any glass or perform roof top ventilation on the exposure. Roof ventilation of the fire occupancy to channel the fire is imperative. This procedure must have both exposure fans started at the same time, Figure 28, otherwise the fire will be pushed into one of the exposures.

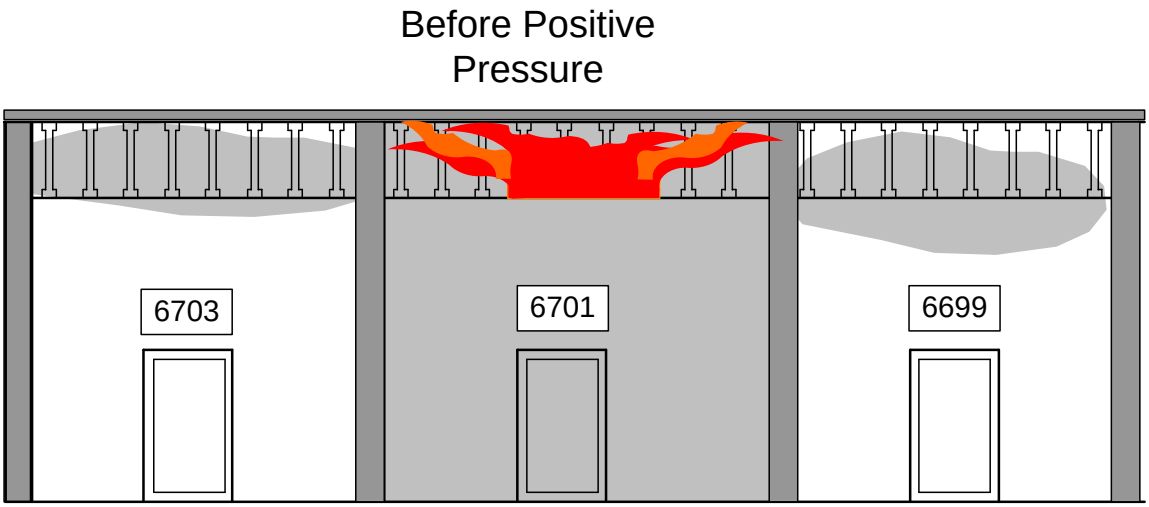

Figure 27 – Fire can rapidly spread horizontally, particularly in those buildings with little or no separations in the cockloft.

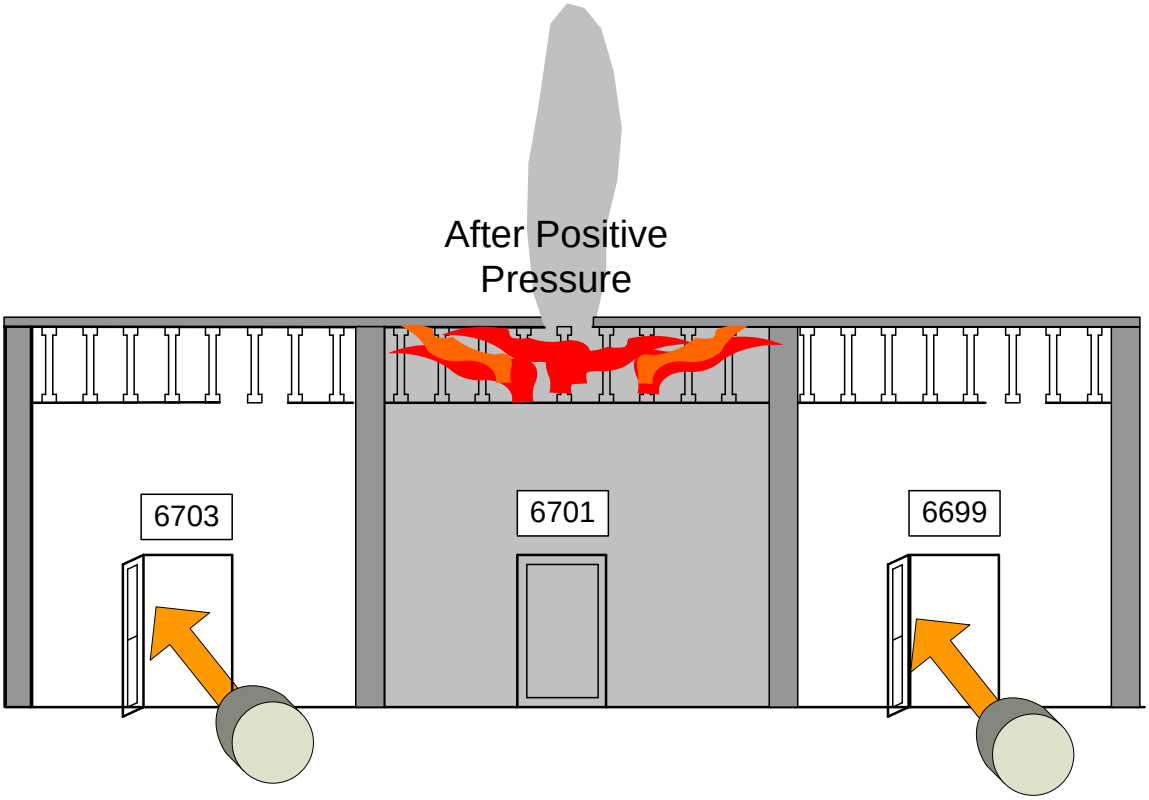

Figure 28 – Both exposure fans must started at the same time, otherwise the fire will be pushed into one of the exposures.

Fire can spread or extend horizontally by various means that include the cockloft, suspended ceilings, air handling ductwork, and utility poke-throughs, among others. Fire can extend via the facade that may have been added to the front wall of the shopping center, Figure 29. Fire rolling out the front show windows can extend up into the facade and then move across the front as seen below.

Figure 29 – Fire can extend via the facade that may have been added to the front wall of the shopping center.

Crews should be wary of the possibility of the facade becoming weakened and collapsing off the front of the structure. A fire in a strip shopping center in Northborough, Massachusetts, shows fire spread to the facade with collapse, Figure 30.

Figure 30 – A fire in a strip shopping center in Northborough, Massachusetts, shows fire spread to the facade with collapse.

Vertical spread is of lesser concern, but still must be considered, particularly in multi-story strip shopping centers. Vertical spread can occur via ductwork, pipe chases, stairways, stud and column spaces behind walls, elevator shafts, stock conveyer openings, and any other vertical artery.

Basement Fires

In circumstances where high heat and smoke to the floor level exist, firefighters should suspect a basement fire. Fires in basements expose the entire structure. Basement fires create added problems to successfully applying water to the seat of the fire.

Basement areas are confined areas with little or no opportunity for ventilation. Firefighters can expect heat conditions to be severe. Since heat and gases will have a difficult time escaping, fog should not be used in basement fire situations. The only exception will be when firefighters are operating from a protected area outside the basement and no firefighters are operating inside.

An outside basement entrance is preferred over interior stairwells if this is an option. If the basement entrance is in the rear of the structure, advance the handline from the engine company in the rear.

The use of exterior streams and cellar nozzles should be considered if the fire is in the advanced stages.

In older buildings that have “taxpayers” above the mercantile stores, the location of the basement entrance is usually found in the rear of the structure. The basement stairway is usually located directly below the stairway leading to upper floors, Figure 31.

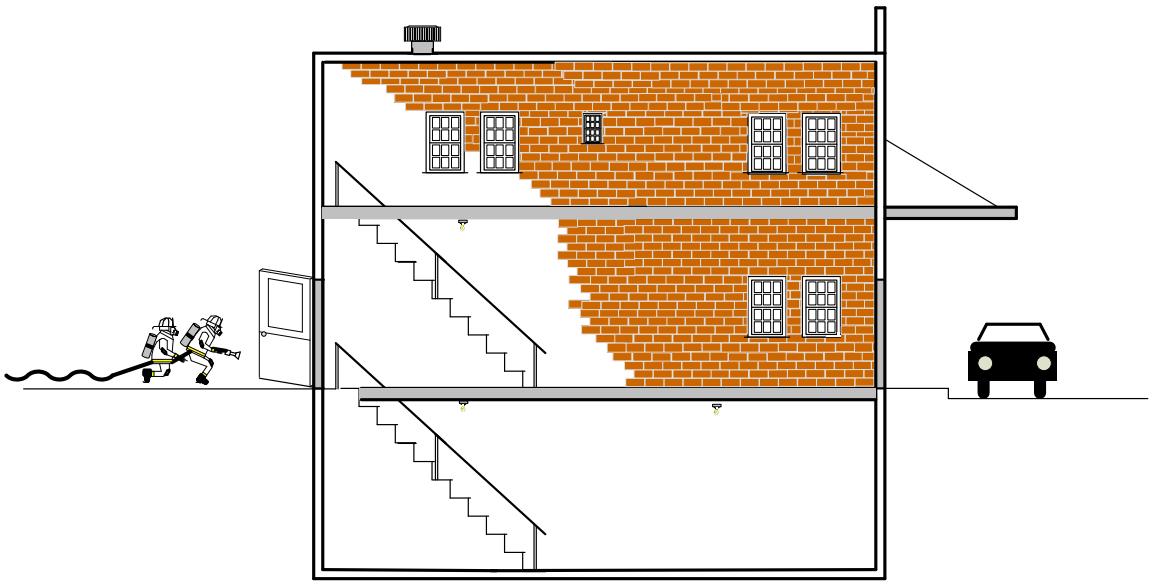

Figure 31 – The basement stairway is usually located directly below the stairway leading to upper floors.

Roof, Attic, and Cockloft Fires

Members who access the roof should be cognizant of hot spots and sagging areas and these areas should be avoided. The roof should be sounded as crews step on to it and as they move across the roof. All members must continually monitor the roof for stability. The OIC should give a brief description of the roof conditions and report any unsafe areas to the incident commander.

Inspection holes will assist crews with determining fire extension, Figure 32. Kerf cuts are not recommended because the melted tar from the saw will normally reseal the cut and make it difficult to evaluate the conditions below the roof. Once the task assigned to the roof crew is complete, all members should vacate the roof. Crews should have an alternate escape route from the roof. Preferably on the opposite side from where they initially accessed the roof.

Figure 32 - Inspection holes.

Extinguishing fires in the areas above the ceilings are difficult to access due to the ceiling height and hidden spaces. It is not uncommon for renovated structures to have more than one roof assembly stacked on top of each other.

Interior crews advancing must check the area above their position in the plenum space above the ceiling. Remove the ceiling tiles at the entrance with a hoseline or long pike pole and use a thermal imaging camera to check the ceiling, Figure 33. Continue this procedure as you advance into the structure. It is best to operate in areas where the fire hasn't advanced above you. Ceiling tile support grid systems can fail entrapping crews below.

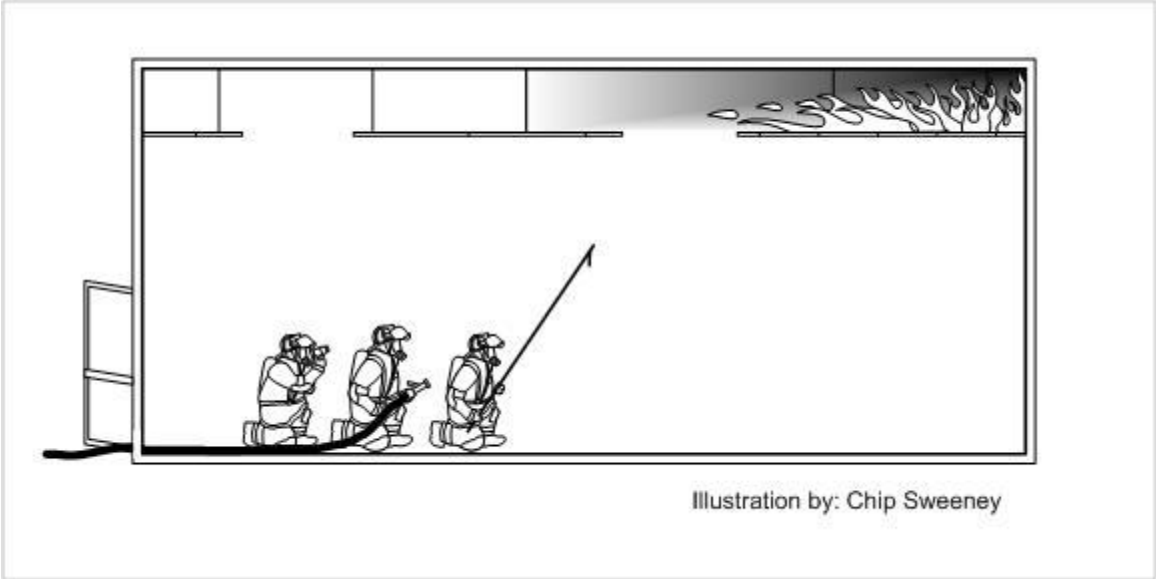

Figure 33 – Crew removing ceiling tiles as they advance.

In renovated roofs where the fire has entered the area between the old roof and the new roof are extremely difficult to access. Operating in a tower ladder bucket independently from the roof is the best means of opening the roof.

Heavy caliber streams should be given consideration for attacking advanced fires under roofs of truss construction. This is particularly true for metal deck roof fires. Directing water upward not only extinguishes the running fire, but cools the steel stopping expansion and significantly reduces the chance of collapse.

Operations in the Rear

The number and size of handlines deployed shall be determined by the flow required and mode of operation (offensive or defensive). Hoselines in the rear are normally used for rear attack, exposure protection, and roof operations.

TRUCK COMPANY AND RESCUE SQUAD TACTICS

Initial Actions

Primary duties that will be assigned to these companies shall include: forcing entry, utility control, ventilation, lighting, laddering, searching for victims, and locating the fire.

Forcible Entry

The initial function is gaining entry in both the front and rear. The rear access is more difficult. Extra security may make gaining entry difficult. Rear door entry and removal of bars from windows is time consuming.

Roll up steel doors themselves present entry problems, but the lock itself may also be an obstacle. The use of multiple case hardened locks is common. Often, these locks can only be opened by cutting them with an abrasive blade power saw or a torch. The best way to access these doors would be to attack the locks and then unlock the slide bolts. Once unlocked, the door or gate will either open by pulling from the bottom or a chain assist winding drum. There are electrical motors that assist with the operation but these are normally found on the interior, especially in shopping malls.

Rescue and Primary Search

The primary concern at strip shopping centers, as in all occupancies, is life safety. Tag lines shall be used by crews working without a hoseline.

Companies must be aware of the potential life hazard in basements and second stories. Company officers must quickly evaluate the life hazard potential associated with the fire situation.

Ladder Deployment

Early laddering of the roof must be accomplished to provide a ready route for crews to assess conditions above the fire and carryout other assigned roof top duties. Once crews are assigned to the roof, at least one additional means of escape must be provided. The ability to access a safe haven on the opposite side of a firewall is considered a secondary egress. Interior roof access from the fire structure before the fire is under control shall not be used.

Crews who get to the roof first should evaluate and communicate conditions to command such as:

- Location and volume of smoke and fire
- Exposure concerns
- Roof loading (i.e., HVAC)
- Evidence of a cockloft fire
- Roof construction hazards (i.e., parapets, changes in roof lines, false fronts, fire walls, etc.)

Egress from the second story is often limited due to fire conditions. These areas must be laddered to provide:

- Roof access and egress
- Second floor rescue
- Escape route for crews operating above ground level

Ventilation

Ventilation, forcible entry, and fire attack must be coordinated. If the building is tightly closed and a significant amount of smoke is pushing, the roof should be opened first to control possible backdraft and flashover situations. In situations where a rain roof has been added, the crews on the roof need to penetrate both the new roof as well as the old roof and remove the drop ceiling in order to effectively ventilate the structure.

Backdrafts can take place in any type of enclosed area of a structure. Although, when they occur in strip shopping centers, they tend to be catastrophic. Built up roofs are time consuming and difficult to ventilate. The delay in ventilation accompanied with large amounts of store front glass in well advanced fires make the potential for backdrafts more treacherous and difficult to alleviate. In well-advanced fires, prior to roof ventilation advancing companies should delay entry and allow the fire to show itself and relieve some of the heat and smoke.

Poured concrete roofs are difficult to ventilate and tools such as a circular saw with a masonry blade is required. In some instances the use of a jack hammer may need to be used. Pre-cast concrete over four inches thick is almost impossible to penetrate. Removing all existing roof opening such as ventilators, sky lights, scuttles, and bulkheads is an option. Horizontal ventilation should also be considered.

The potential for a backdraft is also a possibility in the plenum spaces above the ceiling and in remodeled roofs where the new roof is built over an existing roof leaving dead areas. Flashover is another phenomenon that may be encountered in these types of structures and the tactics are discussed in the tactics section.

Ventilation of the roof must be considered early to relieve conditions for victims and crews operating inside.

Vertical ventilation may be accomplished by the removal of scuttle covers and skylights when present on the roof of the involved structure. The area inside these openings should be opened to check conditions in the cockloft.

When fire has possession of the cockloft, immediate roof ventilation must occur, if safely possible. In addition to the ventilation holes, inspection holes must be cut to determine the extent of the horizontal fire spread. Rooftop ventilation will normally require the services of more than one company.

Open natural roof openings first, choosing those that are over the main body of fire. If needed, a large hole may need to be cut as close as safely possible to the seat of the fire. It is best to start with a small hole, about 2' x 2', and then expand it. A larger hole is difficult to get opened due to the weight of the roofing materials. When ventilating a flat built up roof it is best to remove the roofing material wider than the hole desired. An example would be to clear the roofing material 5 feet by 5 feet for a desirable 4' by 4' hole. A point to remember when removing the metal decking after the final cut has been made. The decking is usually tack welded to the bar joists and a forcible entry bar needs to be used to break the welds in order to remove the decking.

Truck and rescue companies assigned to the roof should be equipped to perform a trench cut. This tactic may be indicated after factors such as available resources, building configuration and volume of fire have been considered. Companies must be cognizant of the fact that a trench cut will require the services of several companies in order to carry out the operation in a timely and effective manner.

Skylights, scuttles, ventilators, and exhaust vents are an excellent quick way to vent a roof system. Cutting along the base of the unit on three sides, then flipping the unit may be your best option. Once the skylight is opened, the interior needs to be checked for sidewalls to ensure that the cockloft is indeed vented if you suspect the fire has entered the cockloft. Shown below is a roof vent under normal conditions, Figure 34, limited smoke removal, Figure 35, and removed for maximum smoke removal, Figure 36.

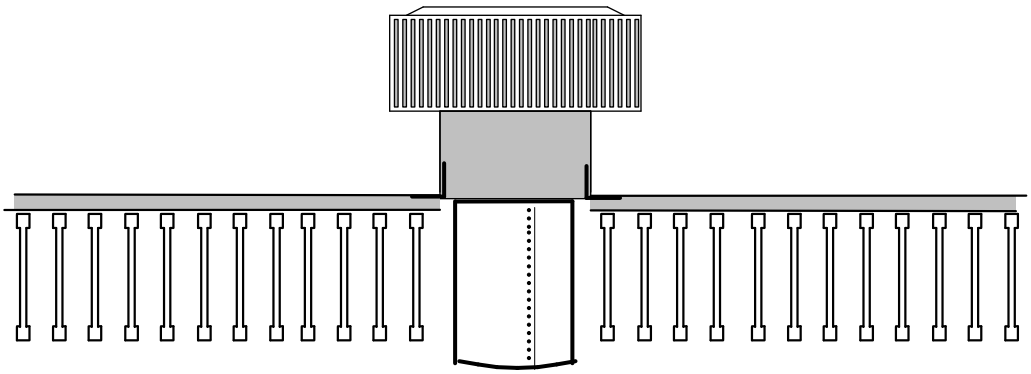

Figure 34 – Roof vent under normal conditions.

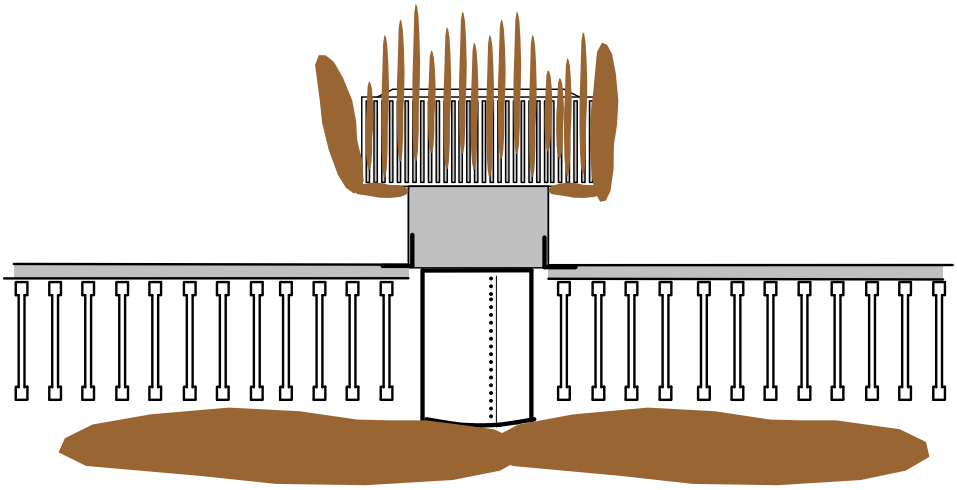

Figure 35 – Roof vent with limited smoke removal.

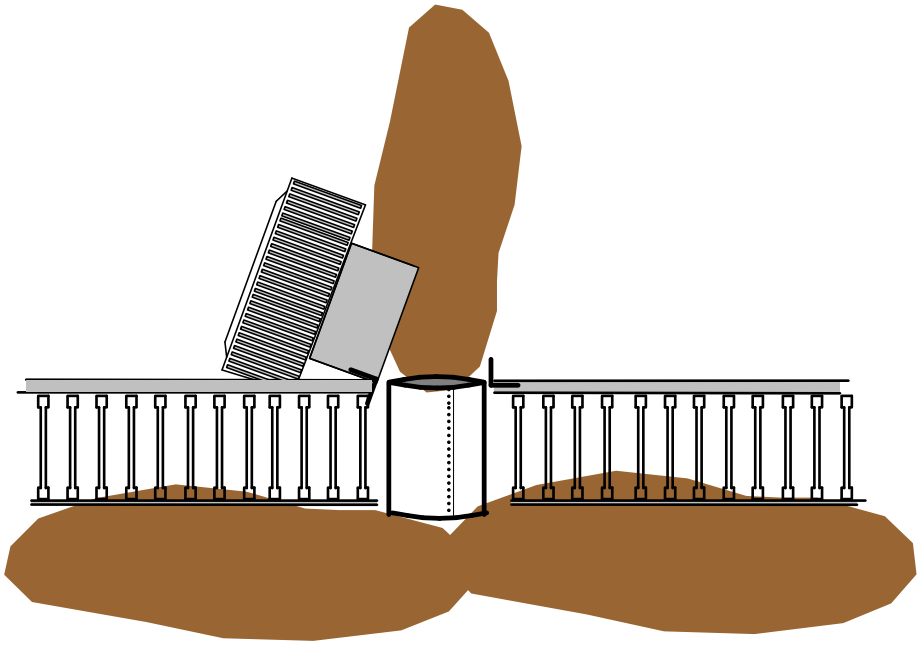

Figure 36 – Roof vent removed for maximum smoke removal.